TRANSMISSION ELECTRON MICROSCOPE (TEM)

Introduction: In 1931, Ernst Ruska and Max Knoll developed the first Transmission Electron Microscope but high-resolution TEM commercialized by RCA Lab in 1940. In 1986, Ruska was awarded the Nobel Prize in Physics for his work on the TEM.

- TEM is an electron microscope that uses a beam of electrons to create an image of a thin specimen, such as a tissue section or molecule.
- TEM is used to study the physical, chemical, and structural properties of materials at the nanoscale.

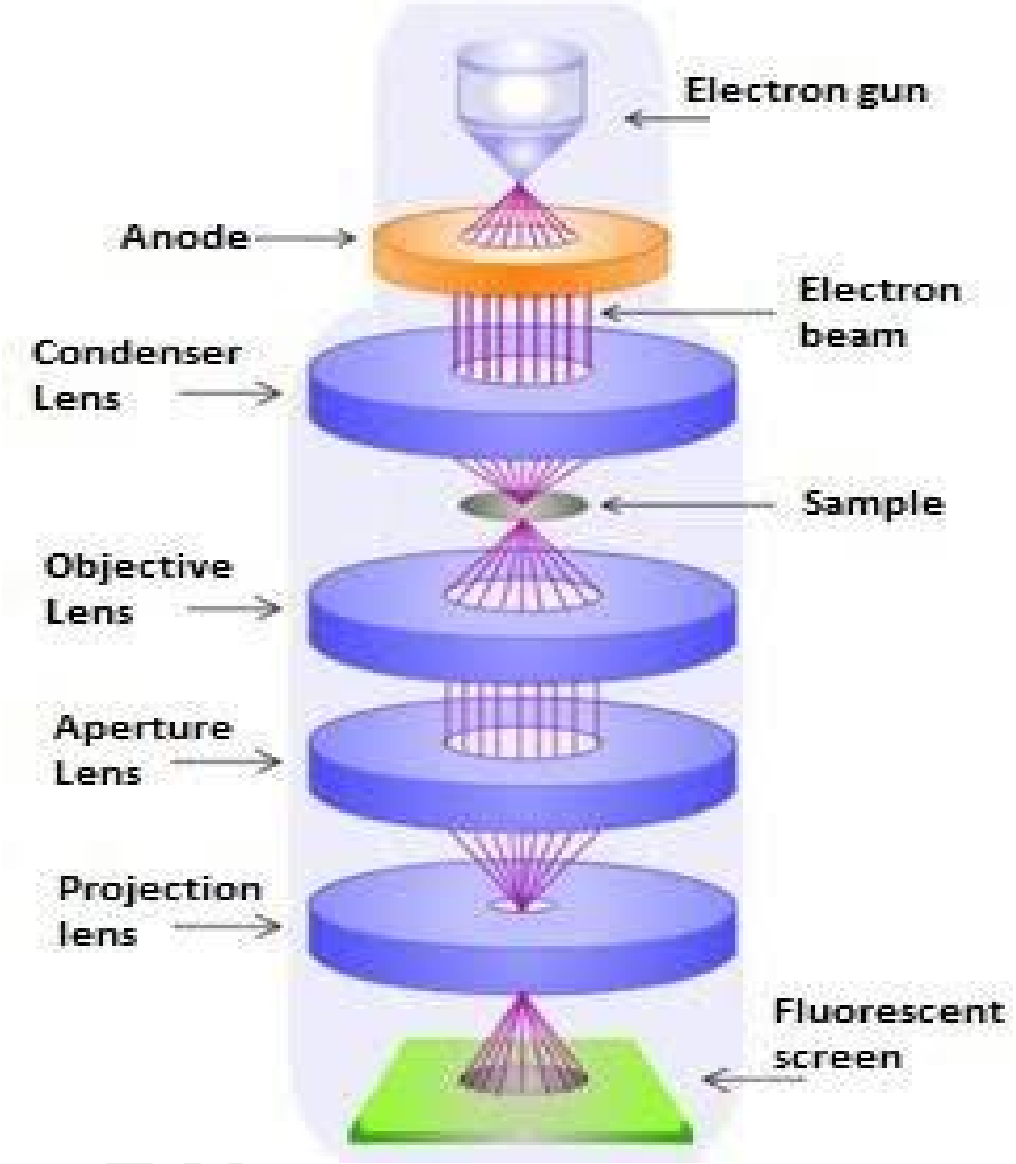
Principle:

- It works on the principle that a beam of high-energy (velocity) electrons accelerated under vacuum, focused by a condenser lens onto a specimen, and the emergent electron beam is focused by the objective lens. The final image forms on a fluorescent screen or camera for image viewing.

Main components of TEM

1. Electron gun
2. Anode
3. Condenser lens
4. Scanning coils
5. Specimen sample
6. Objective lens
7. Aperture
8. Projection lense
9. Fluorescent screen

Diagram / sketch:



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Construction & Working:

- The virtual source at the top represents the E**lectron gun**, which produces a high energy/velocity electron beam. These electrons are emitted from a small area of filament due to Cathode(-ve potential of the electrode).
- These emitted electrons are attracted and travel through anode, there by directionality (parallel electron beam).
- These **parallel beams** of high energy electrons accelerated under vacuum, focused by **condenser lens** (electromagnetic bending of electron beam) onto specimen/sample.
- The **objective lens** focuses the transmitted electrons from the sample into an **Aperture len**s.

- The aperture lens magnifies and focuses the image or diffraction pattern produced by the objective lens. And forms the magnified image on the object plane of the projector lens.
- The **projection lens** then projects the final image onto the viewing **Fluorescent screen** /camera.

Characteristics of Sample using TEM:

1. Sample used in Transmission Electron Microscope have several characteristics.

2.Thin & Vacuum stable

3.Free of contamination

4.Contrast-enhanced

Advantages:

1.High resolution imaging

2.High magnification

3.Versatile applications

4.Provides structural, morphological, and compositional information

Disadvantages:

1.Sample preparation and Vacuum requirement

2.Image is 2D projection

3.Expensive and requires specialized expertise